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ABSTRACT

This book presents materials, activities, background information, and student handouts for conducting educational programs that allow students to explore packaging and handling practices as these relate to waste generation and management options. An educational approach used in the development of these materials is based on the idea that solid waste is one contemporary issue that is conducive to the development of childrens' critical thinking, problem solving and decision making skills. An introduction conveys a historical perspective of the changing nature of waste and waste disposal techniques. The materials are divided into six sections: (1) volume of waste generated; (2) options for handling waste; (3) decisions on packaging; (4) life cycle of product packaging; (5) the aseptic package; and (6) student handouts. The interdisciplinary design of the activities are appropriate for multiple grade levels. While not referenced by grade, the activities are structured so that content, discussion and activities may be adapted to particular classes. Many of these activities are cited as having been tested at varying levels from primary students through adult groups. Activity plans follow a general format beginning with objectives, methods, materials, procedures, and extension activities. (MCO)

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Waste Wise

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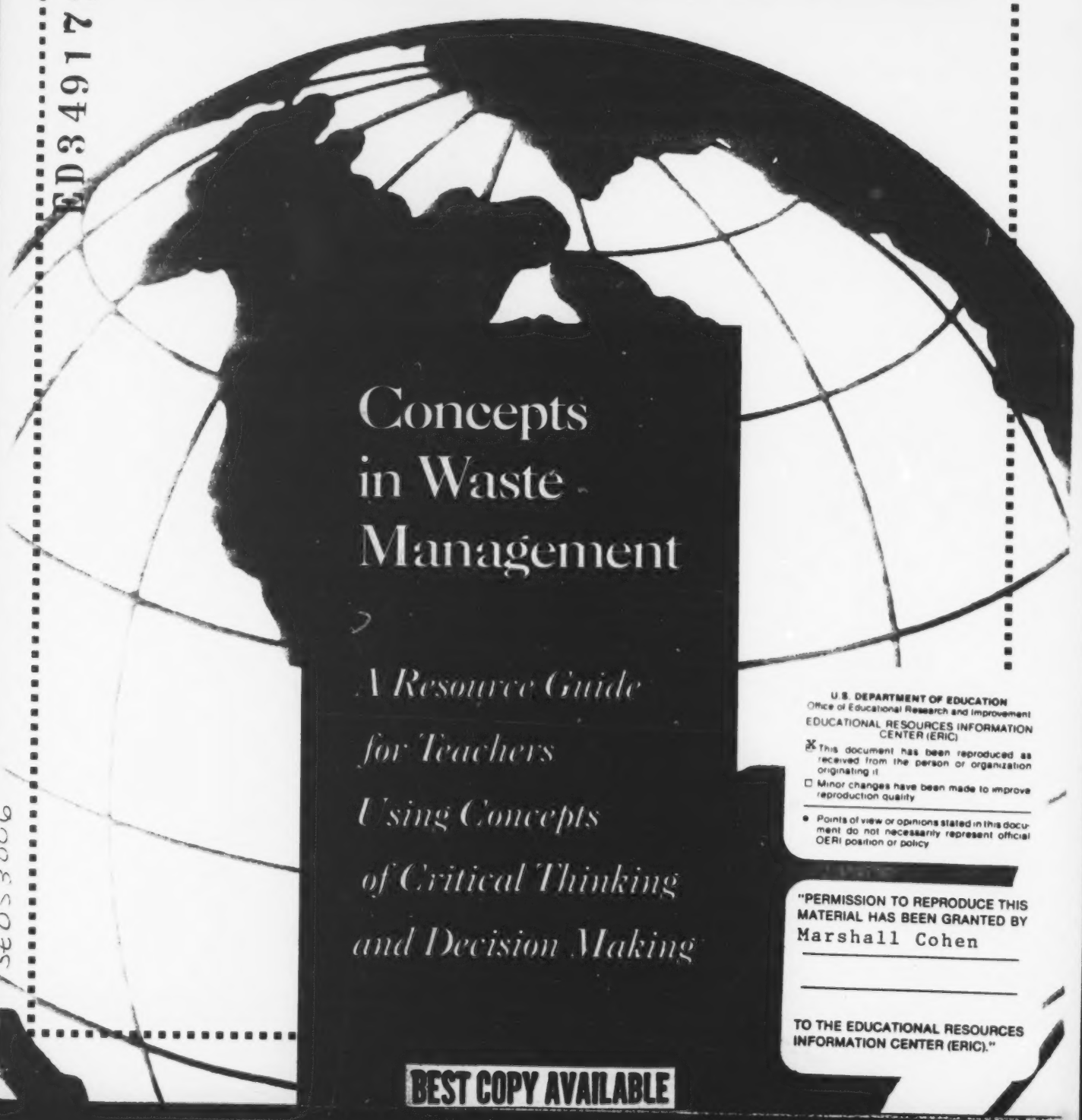

Concepts in Waste Management

A Resource Guide for Teachers Using Concepts of Critical Thinking and Decision Making

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Introduction

The amount of waste we generate in our society is well-documented. Many very excellent educational packages discuss the types of waste we generate and what we can do with this waste. So why do we need yet another set of materials?

As teachers, one of our goals is to provide students with the tools they need for life. These tools include the ability to use critical thinking, conduct problem solving and make good decisions. Perhaps no contemporary issue is as conducive to developing these skills as is solid waste. That is, if we approach solid waste from a different perspective.

Throughout our history, we have viewed waste as out-of-sight, out-of-mind. Let's look at a little bit of waste management history.

In the earliest part of the Roman empire, waste was viewed as something dirty, something to keep out of sight of the senators and the privileged class. As Rome was growing, Roman law required that garbage be hauled one mile outside city limits after dark, thus keeping it out of view. Of course, as the city grew, it continued to grow right over the old pits where waste had been dumped. This caused disease in the "new" sections of the city, so the new city was always for the serving classes.

This mentality has remained throughout the ages. In the late 1800s and early 1900s, a technology was developed called crematoria. A crematorium was a "trash burner" on a cart that was hauled through the streets. People — and in the rich sections of cities, the servants — would carry the waste to the curb and, as the crematory passed, throw the waste into the burner. This "magic" answer to waste management seemed to work ... until the composition of waste changed.

The increase in "disposable waste" in the United States changed the manner in which waste could be disposed. No longer was waste primarily food (which historically had been fed to farm animals), rags and fiber, but waste began to contain more glass and metals. In the late mid-century, aluminum became a larger component of the waste stream. And the 1950s gave rise to what is now known as the "fast" society — fast food, fast cars, fast pace. This fast society was founded upon the concept of disposal. Throw-away items became the norm, not the exception. And in the 1960s, plastic became a significant player in the marketplace.

Today, our waste reflects our lifestyle. This is neither good nor bad, it simply is.

This is the foundation for this set of materials. The options for handling our waste are options, not absolutes. What this packet attempts to do is provide you the teacher with materials, activities and background information for conducting educational programs that allow the students to explore why certain packaging materials are used, what is good about the materials, what the problems with different materials might be and what options exist for handling the materials.

In these materials, an attempt is made to move beyond the "absolute" approach to waste management. The components of this packet are designed to complement other curriculum materials by providing depth to the concepts of waste management that may be missing in the materials.

Today, our waste reflects our lifestyle. This is neither good nor bad, it simply is.

Waste Wise

Introduction & Overview

Overview

The materials in this packet are divided into six sections. The first section is on "Volume of Waste Generated," the second section is "Options for Handling Waste," the third section is "Decisions on Packaging," the fourth section is "Life Cycle of Products" and the fifth section is "The Aseptic Package." There is no presentation "order" to the activities, and there is no need to do all the activities appropriate for any grade or subject. The activities are designed to be incorporated into your curriculum. Many of the activities are appropriate for multiple grade levels. These activities are presented with various options for teaching so that you can determine the depth of learning that will occur. In line with current thought on critical thinking, decision making and problem-solving, the process is the same, whatever the age/grade level. What differs is the depth in which the issue is considered.

To make your task easier, each activity includes necessary background and quick reference facts on the topic. Each section also has a student handout page that can be reproduced. You'll find these in Section VI. The activities on the page can be assigned, done in class or given as an out-of-class assignment. The activities are designed to supplement the class lessons.

Activities are designed to be incorporated into ongoing curricula or into other waste management activity guides. Each activity is designed to stand alone yet may be incorporated into a more comprehensive content package. Ideally, at least one activity from each of the four sections would be completed, yet such may not always be the case. In those situations where time or opportunity for conducting activities is restricted, Activities 2.5 and 4.4 are strongly recommended for classroom use.

The activities are not referenced by grade. The activities are structured so that you can adapt the content, discussion and activity to your particular class. Many of these activities have been tested at varying levels from primary students through adult groups.

Waste Wise

Activities Guide

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Section I

Volume of Waste

Background Information for Teachers

There are many estimates of what is in our waste and how much waste we generate. Yet these estimates often do not fully describe, in understandable terms, what we are trying to say. One issue that is often neglected is that there are many waste "streams." These are called waste streams because they are identified by the "flow" of materials. These streams include:

HOUSEHOLD WASTE STREAM -
the waste from private residences only

COMMERCIAL WASTE STREAM -
the waste from businesses, restaurants and services

MUNICIPAL WASTE STREAM -
the collected waste from a city, community or region

INDUSTRIAL WASTE STREAM -
the waste from manufacturing and processing facilities

INFECTIOUS WASTE STREAM -
also known as "red bag," waste from hospitals and health care facilities

CONSTRUCTION/DEMOLITION DEBRIS -
the waste from building and construction

HAZARDOUS WASTE STREAM -
waste identified as toxic, corrosive, ignitable and/or reactive.

The estimates of waste generated will vary depending upon the stream(s) being examined. For example, the following two tables are estimates of waste by weight of materials in two different streams. Both tables are from data reported by Franklin and Associates, the research firm that provides the U.S. Environmental Protection Agency with its estimates of waste generated:

U.S. Municipal Waste		Household Waste
40%	Paper	50%
7%	Food Wastes	10%
18%	Yard Wastes	15%
8%	Plastics	2%
7%	Glass	8%
9%	Metals	7%
11%	Rubber/Textiles/Miscellaneous	8%

The differences in the numbers reflect the generator of the waste. The activity, "What the Numbers Say," builds on understanding the difficulty in using statistics to describe waste. Another problem identified in the same activity explores the difference between volume and weight in describing waste.

Lesson 1.1
What Is Waste?

Objectives:

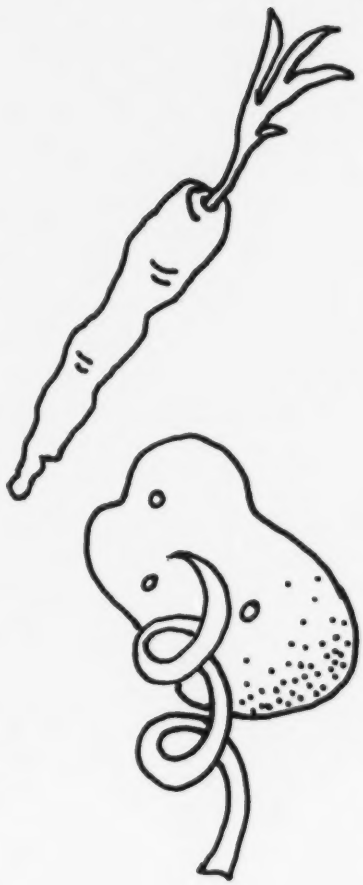
Students will be able to 1) describe what waste is; and 2) define alternative views of what waste is.

Method:

Students attempt to discern the difference between waste and resource through examining use of products and discussing the residual.

Materials:

Two carrots, potatoes or oranges; vegetable peeler; knife; bottle or can of soda pop (cups optional); a T-shirt.



Procedure:

1. As you talk with the students about "resources," show a carrot, orange or potato. Ask the students how a carrot/orange/potato is a resource (food, energy).
2. Peel (or have a student peel) the food. Cut off the ends of the carrot. Ask the students what the peel and ends are (garbage, waste). Ask the students what other things are like this food ... where what we want to eat is "inside" something that we throw away (single serving foods, containers, boxes, etc.).
3. Show another carrot/orange/potato. Ask the students "Where's the waste?" There is none ... yet! Help the students discover that waste only occurs when the <u>desired</u> part of an item is used and the rest is discarded. Waste is only what we no longer want; waste does not mean that there is no value for others in the waste.
4. Have the students try to think of valuable uses for the "waste" generated by peeling the food item. Feeding animals or eating the peel ourselves (baked potatoes or boiled potatoes with skins, carrots with skins, candied orange peels) are both ways that change what is waste.
5. Do the same with the soda pop. Options for not generating waste with the can/bottle include reusing the can or bottle or recycling the can or bottle.
6. Do the same with the T-shirt. If the shirt is worn and too small, what can we do with it? Give it away, use it as a rag, sell it in a yard sale.
7. Waste is only when something is no longer wanted. What do we usually do with waste? (trash can) What would happen if we did not view all these things as waste but as resources for <u>other</u> uses?

Going Further:

1. Have the students keep a list of things that they throw away for one or two days. The list should include things discarded from home. Form teams and have each team compile its list, then identify what resources instead of waste are in the trash can.

2. Students can draw "Decision Paths" for an item of their choice. Have them draw a picture to represent something in the classroom trash can. What can be done with the item? Draw different "paths" the item could take ... such as one path leads to the trash can. Another path might be to reuse the item. How many options can they generate for each item?

3. Have the students create rules for a game called "What Else." The game could be played by having teams compete to try to stump the other side by naming an object for which the other side cannot identify additional resource uses for the used object.

4. Allow students to gather waste items. Challenge them to create an "art piece" using these items to show that what is waste to one person is a resource to another.

5. Suggest that students write an essay, poem or story that demonstrates that waste is only what is viewed as no longer useful. Have the written pieces illustrate that what one person considers waste is possibly a resource for someone else.

Lesson 1.2

Where Does Waste Come From?

Objectives:

Students will be able to 1) demonstrate varying sources (streams) of waste generation; and 2) (more advanced grades/classes) graphically depict waste generation amounts.

Method:

Through a question/answer approach, students will discover that waste comes from different sources. Discussion will be used to extend this discovery to contrast differences in waste streams. Graphic arts and math can be incorporated through depiction of differences.

Materials:

Chalkboard and chalk, or flip-chart and pens; pie tin; box; 100 coins, marbles, chips or similar items.

Procedure:

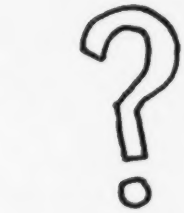
1. Ask students where waste comes from. As they respond, write all answers on the board. Probe to include hospitals, factories, stores, restaurants, hotels and offices.

2. Ask the students if the waste from all these places is the same. Encourage them to mention differences.

3. Have the students tell you which of the places they identified in the list would be similar in waste generation. Reconstruct the list to "cluster" the places.

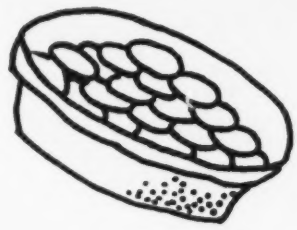
4. Share the table that appears in the introduction to this section. Discuss.

5. As a class, or in teams for each cluster, describe the uniqueness and the similarities of each cluster.



FOR MORE ADVANCED MATH GROUPS

6. Pie charts: Place all the marbles, chips, coins or whatever in the pie tin. This represents the "waste stream." Ask the students how it would be easier to understand the difference between "streams" such as household and industrial waste streams. Probe until the concept of components or different amounts of the waste stream emerges. Demonstrate how percentages work — if all the waste were equal to 100 marbles/chips/coins, we could say that x number would be this type of waste: in every 100 pounds (or parts) of waste, so many pounds (parts) will be this type. Have the students draw pie charts to show differences between waste streams.



7. Bar graphs: As above, but suggest that if we put all the waste in a box and place it in layers (either vertical or horizontal) according to type, we could look at the end or the side of the box and "see" how much waste there is according to type. Illustrate this, perhaps using colored blocks.

Going Further:

1. Have students talk with their parent(s) about the parent's workplace. What types of materials are discarded where the parent works? Have the students compile and compare answers.

2. Students can write letters to the local landfill operator and request information on types of waste from different sources. They also may be able to secure information on percentages of different waste going into the fill.

3. Using increments of 100, have students count what goes into the classroom trash can. Students may also do this at home. What differences are there? Can they chart or graph these differences?

4. Have students depict differences in waste streams by creating montages.

5. Have students identify two different waste streams. Then, on a piece of paper, have them make two columns of the alphabet. Over the first column, write the name of one of the waste streams;

over the second column, the name of the other. For each letter of the alphabet, the student should write (if possible) some type of waste that comes from that waste stream that begins with that letter. Suggest that the students try to come up with different wastes for each column. This could be done effectively in noncompetitive teams.

Lesson 1.3
How Much is Much?

Objectives:

Students will be able to 1) explain in their own terms what is a ton and other amounts; and 2) discuss relationships of volume.

Method:

Students are challenged to turn concepts of large numbers into "real things" by creation of examples.

Materials:

Scales, paper, scissors, pencils, blocks, chips, coins, marbles and anything in the classroom!

Procedure:

1. This activity can be used in any lesson where content presents concepts of large numbers.
2. In solid waste, we often talk about tons. For example, we can say that in our state, so many million tons of waste was landfilled in one year. But how much is a ton in concepts that we can understand?
3. Discuss the concept of a ton. If a ton is 2,000 pounds, what is a pound? Have students form teams of three. Each team is to choose some small item in the room. The team should weigh that item and record its weight.
4. How many of those items will it take to make a pound? Gather that many items.
5. Show how many of each team's items it takes to make a pound by a drawing.
6. Have each team collect as many of its items as the team can. How many did they get? How many pounds would that be?
7. Have each team prepare a visual presentation for the rest of the class on the weight of their item and how many items it will take to make a ton.
8. Use this same approach to discuss million or billion.

Going Further:

1. Have each team draw a picture of how many items it will take to make a ton (or million or billion).
2. Have the students identify how many of their items it would take to equal an average daily waste generation rate of 3 pounds; 5 pounds; 7 pounds.
3. Give the students this fact:

If every person in New York City threw away one 16-ounce pop bottle, there would be 3,516,589.5 pounds of empty pop bottles — the equivalent of 440 full grown elephants (by weight).

Challenge the students to come up with ways to describe weight. How creative can they be?

Objective:

Students will be able to describe the path that waste materials follow from the home to the landfill.

Method:

Discussion and communication strategies will be used to help students discover what happens to waste.

Materials:

A trash can; waste materials; toy truck or wagon; two, three or four boxes.

Procedure:

1. Introduce the concept of waste management. What happens with waste? In our society, many people never consider what happens to the waste. It is put into the trash can or the bag, and then it "disappears." What happens after it leaves the house, the office or the factory?
2. Place the trash can on a table or desk. Ask the students what happens once the trash is placed out for collection. Probe for the "next step," which is collection and hauling. When this is said, take some of the trash from the can and place it on the truck or wagon.
3. Ask where the truck goes. There are several answers that may all be correct, depending upon the community. It is especially good with older students to discuss options that may not occur in the immediate community, but are used in other communities. One of the stops may be to a "transfer station" where the waste is col-

Section II

Options for Handling

Lesson 2.1
Where Waste Goes

lected by the smaller compactor trucks and then transferred to a larger "over the road" truck. Why would communities do this? (It is less expensive to have larger loads go longer distances; the compactor trucks that collect waste are expensive to operate, usually have more than one person — which means the time on the road is costing two people's time — and do not hold much waste and so lose time from collecting materials). Put some of the waste in a box and label it "transfer station."

4. Ask where else the truck might go. Another answer might be a "MRF" (pronounced "murf"), which is a Materials Recovery Facility. The MRF is where materials are separated for recycling. If there is a curbside recycling collection program in the community, the recyclables are collected and taken to a MRF where they are put into larger trucks by item to be taken to the buyer. Put some waste from the truck into another box that can be labeled "MRF."

5. Where else might waste go? And where does waste from the transfer station go? Ultimately, much of the waste goes to a landfill. Put the remaining waste from the truck into a box to be labeled "landfill."

6. What happens in our community? Discuss. Have students write letters to the waste hauling companies in the community to find out what they do with the waste they collect.

Going Further:

1. Have the students draw a picture that represents the path of waste in the community. Is there one place waste goes, or are there different places for different parts of the community, different types of waste or different companies? Why are there differences?

2. As a part of the letter to hauling/collection companies, have students ask about the cost of hourly labor, operating different types of trucks, who owns what facilities and the costs to "tip" (or "dump") the waste at different places. Try, as a class, to determine which path of waste is the most cost-effective for the community.

3. Why do we pay money to tip waste at landfills, transfer stations or MRFs? If possible, tour different facilities or have speakers from different facilities or waste hauling firms talk to the class. What are the factors that make waste disposal so expensive? (labor, land, equipment, regulations, permits, etc.) Someone from the county health department also may be available to talk to the class about what happens to waste.

4. One of the myths about landfills is that things will "disappear" in landfills. This is why some people think more waste should be biodegradable. To biodegrade, oxygen and moisture are needed along with microbes and bacteria. Yet the action of moisture and air in a landfill could create a seepage of materials (some toxic) that might in certain conditions be a threat to groundwater. In a landfill,

what happens? Is there free flow of air? Of moisture? Why do we find newspapers and foods that are still recognizable many years after being put in a landfill?

Lesson 2.2
Building a Model of Waste Management

Objectives:

Students will be able to 1) create a visual model of waste management; and 2) be able to discuss paths of waste flowing through the model.

Method:

Group process will be used with guidance; visual modeling and drawing will allow students the opportunity to commit the concepts of the model to their understanding.

Materials:

Signs or posterboards with the words: Reduction, Reuse, Disposal, Recycling, Composting, Incineration (burning), Landfill; eight signs or posterboards with arrows; tape; index cards (multiple colors).

Procedure:

1. Talk with the students about waste management being expensive (the third-highest cost to the local government, and in some communities even higher). What would most significantly lower the cost of waste management? The answer you are seeking is to produce less waste. How do we do this? Two primary ways. Probe until students say "reduce." Reduction is not purchasing materials that will generate waste in the first place. Put the sign "Reduction" on the wall.

2. Ask what would be the next way that we can produce less waste. The answer you are seeking is "reuse." Reuse is using an item again, thereby lowering the need to purchase another item. Reuse, however, is a postponement of disposal. Antiques, yard sales, hand-me-downs, secondhand stores are all reuses, but the items will eventually be thrown away. Put up the sign "Reuse" below the "Reduction" sign. Place an arrow down from "Reduction" to "Reuse."

3. At some point, the items we purchased are no longer wanted. What do we do with them? We dispose of them. Put an arrow down from "Reuse" and below the arrow put the sign "Disposal."

4. However, we have some options for disposal of used items. What are the options? Probe until you get "Recycle," "Compost" and "Burn or Incinerate." Put these three signs in a line below "Disposal," with arrows pointing to each of the three. (Composting is

the controlled biological degradation of organic material; incineration is a controlled, high temperature burning of combustible materials.)

5. Some things cannot be burned, decomposed or recycled. And in processing materials for recycling, composting or incinerating, some waste is generated. What do we do with all this waste? The answer we are seeking is "Landfill." Put arrows from each of the three options pointing toward the sign "Landfill" below them.

6. Tell the students that this is a model of waste management. A model represents what happens in the real world. Why are models useful? (To let us view a process; to analyze what happens; to make changes.)

Going Further:

1. Divide the class into several groups. Give each group a set of notecards. If possible, have each group use a different color of notecards. Assign each group a type of waste material such as metals, paper, glass, plastics or yard waste. Each group is to discuss what could be done to 1) reduce the amount of that type of waste generated; 2) reuse that type of material; 3) determine what products of that material are often disposed of in the home or school; 4) determine if and how that material can be recycled; 5) determine if that material can be burned; 6) determine if that material can be composted; and 7) determine what is made of that material that is always landfilled. Have them write their ideas on a card for each of the seven discussion points. The group then presents its ideas to the class. Have each of their seven cards put on the wall beside the appropriate sign.

2. Have students create their own models of waste management. Suggest that they use items of trash to represent stages of the model. Sculptures, mobiles and posters are all good options.

3. Have the students discuss how options for waste management are made. Can they "classify" waste materials? What is the benefit?

Lesson 2.3
Integrated Waste Management

Objectives:

Students will be able to 1) explain the concept of an integrated waste system; 2) apply concepts of decision making to waste management; and 3) use critical thinking to consider options for waste materials.

Method:

Group decision making and problem-solving will be used.

Materials:

Chalkboard; chalk; signs from previous activity (optional but useful).

Procedure:

1) Have the students reflect on a model of waste management. How are decisions made? Who makes them? Why are they made?

2) Who makes them? Some decisions are made by consumers (to buy less). Some decisions are made by manufacturers (to produce or not produce). But manufacturers produce only what consumers will buy. Who else makes decisions? Local officials, citizens, industry and business all help make decisions.

3) Why are they made? Sometimes laws require communities to make decisions. Sometimes public pressure. What other reasons might require communities to make decisions on how they handle waste?

4) What is a major problem with making decisions on solid waste? One big one is that, traditionally, we put all our waste into one bag or container. Then it is all taken to one place. What we want to do is to take different materials to different places — recyclables to recycling centers or programs, compostable materials to a compost facility, combustible materials to an incinerator. How can we do that?

5) The key is separation for participating in an "integrated waste management system." What does integrated mean? (A combination of source reduction, recycling, composting, incineration for energy and landfilling.)

6) Ideally, we want to take each item through the waste management model that costs the least and gives us the most value in return. This is why "waste" is really a resource. It is only waste when it has no value. How can we do this? At what point on the model can we get the materials to the right place? How do we do this for recycling? (Separate at home.) Source separation is the idea that each household separates different types of materials so that they can be collected separately for different purposes. There are some programs in which mixed materials are collected and separated at a facility (like a Materials Recovery Facility or a "front-end separation program," where all materials are separated manually and technologically).

7) What do we do in our community? What could we do? Discuss.

Going Further:

1) Hold a town meeting. Assign students (or secure volunteers) to be mayor, city council members, planners, interested citizens, health department officials, waste hauling firms and other relative groups. The purpose of the meeting is to discuss options for waste management in the community.

2) Write letters to managers of different waste management facilities, or have representatives from these facilities speak to the class. Ask them what types of materials are best captured through their facility, what materials cause problems in their facilities and what things are the most expensive about their operation. As a class, chart concepts from responses/presentations. Discuss implications for the community.

3) Have the class prepare "television public service announcements" regarding integrated solid waste management in our community. If possible, videotape the PSAs. Have the class watch the final products. What message is each tape trying to present?

4) Divide the class into two groups. One group will support the concept of landfilling the waste of the community. The other group will support the concept of an integrated solid waste management system for the community. Have each group prepare arguments in favor of its position. Additional research may be needed! Allow the teams to debate each other; following the debate, discuss the concepts brought out in the debate.

Lesson 2.4
It's a Big Deal?

Objectives:

Students will be able to 1) describe some concerns of waste management; 2) distinguish social issues related to waste management from technological issues of waste management; and 3) identify activities of waste management that would make the most impact on the solid waste crisis.

Method:

Through modeling, students will discover that some of the "hot" issues in solid waste management would address a very small part of the waste stream. Students will discuss ways in which the larger issues can be addressed.

Materials:

One hundred pieces of paper taped to the wall; scissors.

Procedure:

1. Ask the class what they consider to be "hot topics" in solid waste. Along with recycling, some of the ideas may be foam boxes (polystyrene foam), drink boxes (aseptic packages), bottle bills (forced deposit legislation), etc.

2. Share with the class the following figures:

Percent of U.S. Municipal Solid Waste by Weight
(U.S. EPA 1990)

Paper	40
Yard Waste	18
Food	9
Plastics	8
Metals	8
Glass	6
Other	11

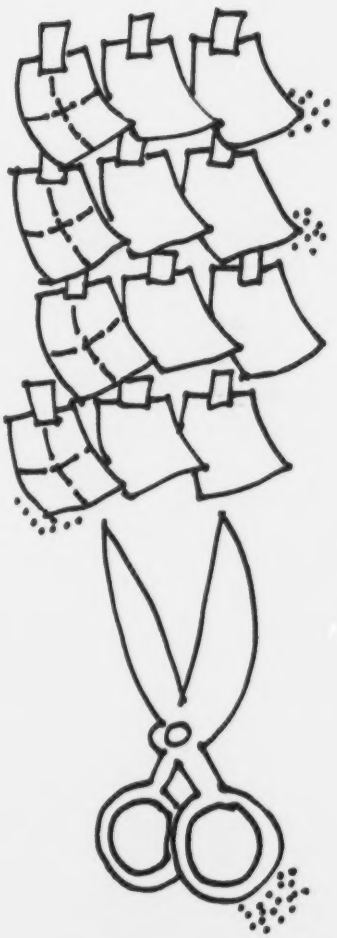
3. Have the class look at the sheets of paper. If this paper is all solid waste, about three of the papers represent beverage containers. Have a student mark three of the pages. Some people spend a great deal of energy talking about the drink box or milk carton, yet the drink box is less than .03 of one of the pages. (Cut off a very small strip of the paper. On an 8 $^{1}/_{2}$ x 11 inch sheet of paper, this would be less than a $^{1}/_{8}$ inch strip cut from the 8-inch side of one sheet of paper.)

4. Another item many people spend a great deal of energy on is plastic and paper diapers. These are not quite 1 percent of the waste stream (mark another sheet a different way).

5. Some people also spend a lot of time worrying about the foam boxes. Before McDonald's stopped using foam, it made less than one-quarter of 1 percent of the total waste (divide one sheet in four, and color one section).

6. Are these important issues? Looking at all the paper on the wall, there's a lot of other "stuff." You can have students mark papers according to percentages of waste. Which percentages are the largest? What would make the biggest differences in how much waste is landfilled?

7. Why do some people consider the above issues important? What does the class think are the issues that are most important to total waste management?



Going Further:

1. Have the class ask their parent(s)/guardian(s) what they believe are the most important issues in solid waste. Compare answers. Does the class agree with the list? Why or why not?

2. Have the class form in groups of four. Each group should decide if they were able to prioritize waste management research and development, what would they consider the most important topics? Have groups compare and debate their answers.

Lesson 2.5
Values and Products

Objectives:

Through this activity students will 1) identify the hierarchy of waste management; and 2) discern the value of different products relative to the hierarchy.

Method:

Discussion and negotiation will be used by the class to construct a means of recording and predicting values by use of a matrix.

Materials:

Chalk, chalkboard; paper/markers; signs from 2.2 if available; aluminum can, glass bottle, drink box or other plastic-coated paper product, plastic jug.

Procedure:

1. If the class conducted the Lesson 2.2, use the signs and hierarchy from this activity. If the class did not do Lesson 2.2, discuss the values in different waste management strategies: reduction keeps materials from the waste stream; reuse postpones products' entering the waste stream; recycling saves resources and often saves energy; composting (often called nature's recycling) recovers the values of organic materials; and incineration recovers the energy of products. Put these concepts on the chalkboard.

2. Ask the class to list different materials. If the class does not include them, probe to get the items you have collected (jug, bottle, can, drink box). Ask the class how we might determine which items have value in different steps of the hierarchy?

3. Allow or lead the class to the concept of a matrix for comparison. Have the class structure such a matrix. (Very likely across the top will be the steps of the hierarchy, while the side will list the various materials.)

4. Complete the matrix by asking if each item is a good product for:

   - reduction (bottles, if refillable; drink boxes are a reduction package)
   - reuse (bottles, if refillable; jug)
   - recycling (we have good technology for recycling glass, metals, plastic and the drink boxes!)
   - composting (the boxes are 65 percent organic, and the 35 percent remaining can be recovered in the process of municipal solid waste composting; glass, metal and plastic are recoverable in the separation but are not at all compostable)
   - incineration (drink boxes and plastic jugs are combustible)

- landfill (the boxes are the best volume reduction material; plastic jugs are the best weight reduction material).

5. What does this type of analysis of products do?

Going Further:

1. Have the class consider alternative means of presenting the information — can they develop graphs? Pictorials?
2. As consumers, we often must make purchase decisions based on little information. Does this type of information help us make decisions? Does it make decisions harder? Why?
3. What information did the class need to complete the matrix? What information is difficult to know (such as that plastic jugs and drink boxes are recyclable in some areas of the United States)? How can "average citizens" learn such information? What would make such information more available?
4. What are other types of information for which matrix analysis would be useful? Divide the class into groups and have each group develop a matrix that analyzes some decision process.

Section III

Decisions on Packaging

Lesson 3.1

The Purpose of the Package

Objectives:

Students will 1) recognize that packaging is essential; and 2) identify the various reasons packages are used.

Method:

Illustration and discussion will allow the students to discover the uses for packaging.

Materials:

A fresh egg and a bowl; an orange; various packages; various packaged products (household cleaners, boxed food stuffs, personal items, etc.).

Procedure:

1. Tell the class that you are going to discuss packaging. Put on display all the items you brought. Ask the class which of the items are "packaged."
2. Demonstrate that the egg and the orange also are "packaged," but by nature. Break the egg into a bowl. Would they want to buy the egg without the shell? What about the orange?
3. Ask the class why items are packaged. Have a student record on the blackboard the ideas of the class. The ideas should include:
   - Protect the item
   - For shipping the item
   - For storing items
   - To advertise/promote the item (make the consumer want to buy)
   - For safety (safety seals)
   - For convenience
   - Prevent theft
4. Compare and contrast the different packages you brought. Why are there different shapes? Are there special reasons for the different shapes and materials? Do different materials do special things?
5. Ask the class if packaging is necessary. Talk about where most people live (in cities or towns). Where are foods grown? Where are products manufactured? How do we get products from where they are grown/manufactured to the people who need them? Is packaging necessary to protect the items, to ship the items and to keep the items clean and fresh?

Going Further:

1. Why do manufacturers decide to use certain materials for packages? Have the students suggest different reasons. Have students write down the different reasons. Over the next few days, have students collect packages that represent the different reasons they identified. Do some packages fit more than one? Do some packages not fit any of the categories the class identified?
2. Introduce the concept of economics into the decision for packaging. Companies want to make the most money while spending the least. Yet packaging accounts for every $1 out of $11 spent on consumer items. Why is this cost so high? Do companies make decisions to use different packages to save money?
3. Choose four or five very different shaped objects. Have the students select one of the items and design a package for the item.

Does the package provide for all the things a package should do (protect, facilitate shipping, storage, marketing, safety, convenience)?

4. Have teams of students create packages for different products. Allow each team time to present its package and tell why they created it the way they did. Have each team also explain the waste that its package may generate. What options might they consider?

5. For more advanced classes: Graph the economics of centralized versus decentralized production. Why is it cheaper (or not) to produce products in one place and ship them, even though packaging and shipping are expensive, rather than having decentralized production (or many smaller manufacturers all over the country/world)?

Lesson 3.2
Decisions on Packages

Objectives:

Students will be able to 1) state needs of products; 2) state needs of packaging; and 3) reconcile the needs with the environmental sensitivity of the package.

Method:

By example, students will discover that products and packages have "needs" that must be met through packaging. In discussion, students will explore the environmental sensitivity of packages. Critical thinking will be used to create an understanding of how decisions on packaging could be made by manufacturers.

Materials:

Various packages; water in glass; light bulb; pen; paper clip; piece of paper; box with packaging material (foam peanuts, paper, tissue); a toothbrush in a box wrapped in plastic; a food mix box with two or more bags in the box.

Procedure:

1. Either have students bring various packages from home or have an array of packages for example.

2. Show the glass of water. Tell the class that you are going to "sell" the water. What do you need to do? What if you want to sell the water but not the glass in a store? The answer is you need first to design a package for the water.

3. Show the light bulb, the paper clip and the piece of paper. Tell the class you also want to sell these items. Will the package be the same as for the water?

4. Examine the packages the students brought from home. Each student can tell why the package he/she brought is made from the material it is and shaped the way it is.

5. Even if we "capture" the material in a container, though, we still have to get the container to the store. Many times, decisions on packages are made considering what the package must go through. Show the box filled with "foam peanuts" or paper or tissue, the toothbrush and the box of paper staples. Why is there the material in the one box? (to protect from breakage) Why is the plastic around the toothbrush box? (to keep it clean) Why are there different bags in the box? (to keep things separate until they need to be combined) These are needs of the package: to protect, keep clean, keep separate. What might be other needs of packages or products?

6. When a manufacturer is considering packaging a product, what kinds of questions might be asked? Are they going to be the same kinds that we just discovered? Why or why not?

7. How can we make packages both environmentally sound and still meet the needs of the product and the package? This is a difficult question ... and there are no limits to the ideas and inspirations.

Going Further:

1. Write on the chalkboard "earth, water, air, fire." Have the students create symbols to represent each. Then, come up with a package for each item. Does the package meet the needs of the product? How will the package serve its own needs for shipping, safety, protection, separation?

2. Part of the needs of the package is to market the product. Do consumers read the weight of the product or look at the size of the package? Are bright colors more attractive to consumers than dull colors? Have each student (or teams of students) select a material he/she believes to be environmentally sound. Design a package using that material for a product for which it is not usually used. Are there problems? How will the package be manufactured? Will consumers like the new package better than the old one?

3. Have the class create a display of packages. Have the students identify the needs of the product and the needs of the package for each item in the display. How can each item be made more environmentally sound, if possible?

Lesson 3.3
Crush!

Objectives:

Students will be able to 1) describe the concept of volume related to waste disposal; 2) measure volume of materials visually and/or mathematically; and 3) contrast volume by whole versus crushed materials.

Method:

By contrast and measurement, students will explore the concept of volume of waste by package material in disposal.

Materials:

Glass container (jar); metal containers (aluminum, steel, bimetal); paper box; drink box; newspapers.

Procedure:

1. There are many different issues related to the landfilling of products. All of the issues ultimately reside with the question, if this is the "ultimate" disposal, how can we have the item take up the least amount of space possible? This question is not unlike the question asked regarding recycling: If we must ship products to be recycled, how can we get the most product in the truck to make the trip worthwhile? Discuss impressions of the class regarding hauling and disposing of items. What items take up a lot of space? What items take up little space? What items are heavy? Light?

2. Introduce or reintroduce the class to the mathematical concept of volume. How does the class see "volume" relating to transportation or disposal of solid waste?

3. Show the class the various containers (glass jar, metal cans, cardboard). Discuss the volume of each as they exist. What could we do to make them smaller? Crushing is a form of "volume reduction." But in volume reduction energy is expended. Part of the value in recycling is the saving of energy. We want to use the least amount of energy possible to reduce the volume of the material. We can compare the energy necessary to reduce items by exploring the weight necessary to crush items without force.

4. Place newspapers on the floor. On top of the stack, place one of the containers. Place newspapers on top of the container. Have a "lightweight" student stand on the container. DO NOT STAMP! We want the "weight" not the force. Have this student stand on top of the newspapers. Do any of them "crush" at that weight? Go on to other students who weigh more.

5. An alternative would be to place the containers between sheets of wood. Add students or weight onto the top piece of wood. At what weight does each item crush?

6. Discuss what happens. What is different in garbage collection than in this experiment? (In collection, items are crushed from different angles and in different configurations, which cause crushing to be an inexact science.) Try some of the items on the side — cans crush with less weight on the sides than they do from the top.

7. What is the value of understanding volume reduction? How can we apply the concept of energy savings to volume reduction, hauling and recycling?

Going Further:

1. Have the class design a controlled experiment in which students gradually add weight (not force!) to determine the weight at which an item will be crushed. What factors must the class consider (variables such as PSI versus total weight, stress points, angles, etc)? Create charts that illustrate the results of the experiment.

2. The class may choose to add the concept of force to this experiment. How can force be applied? How can it be measured? Can the class design an experiment that will do this?

3. Using observations of the in-class exercise, can the class "predict" what items will crush with the least energy? What about when items are inconsistent in position?

4. What does "shape" of a container have to do with the container's "crushability"? What would be the requirements for an ideal container related to volume reduction? What shape would it be? Draw pictures.

5. Weight and volume are both used independently to describe waste (tons or pounds is used as well as cubic yards). Is there a way the class can compare package items by both weight and volume (collapsed or crushed)? What packages seem to be better in terms of weight and volume?

Lesson 3.4
Do's 'n Don'ts

Objectives:

Students will be able to 1) consider issues related to packaging and waste management; and 2) discern positive consumer behaviors.

Method:

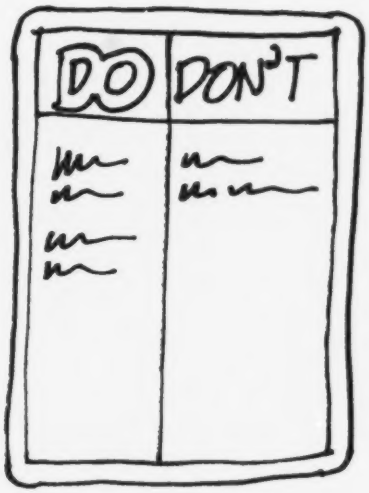
Students will discuss and brainstorm ideas. Discussion will focus the ideas into critically considered behaviors.

Materials:

Chalkboard; chalk.

Procedure:

1. Ask the class if it believes there are any really good or really bad packages. Discuss the concept that the same package may be viewed by different people as good and bad at different times. For example, many people consider disposable baby diapers as bad ... unless they are working parents who must provide diapers for day care!



2. Tell the class that you would like it to develop a list of "do's and don'ts" about buying things. On the chalkboard, write the word "DO" on one side and the word "DON'T" on another. Ask them what they think they can do when they're in the store to help cut down on package waste.

3. As students offer suggestions, write down their ideas into either column depending on whether the suggestion is a do or a don't. Some ideas under DO might include: do bring a tote bag with you, do buy products in bulk or without packaging, do buy concentrates when possible.

   Some ideas under DON'T might include:
   - Don't have items double-bagged.
   - Don't buy things in blister packs (transparent plastic bubble mounted on a paper or plastic board). Screws, tools, kitchen supplies, staples, cosmetics, etc. are often blister-packaged when they do not really need to be.

4. Ask the students if it is possible to obey all the "do's and don'ts" they named all the time. Why or why not? What products would they not be able to get?

Going Further:

1. Assign students a "section" of the grocery, hardware or department store. Have them take a copy of their list with them. Have them record what products they could purchase that would fit the list and what products they would not buy because of the rules on the list. Share the findings and discuss.

2. Divide the students into small teams. Each team is assigned a different type of retail store. Have them list the types of goods they will sell. For each of the types of goods on their lists, have them consider the types of packaging that the goods are sold in. If some of the things they sell are not purchasable according to the Do's and Don'ts list, what will they do? What are the benefits to the materials being in the types of packages they are? What other way could the store sell the items?

3. Have the students write short stories to demonstrate why it is difficult to ever say that something is always bad. These could be fictional stories or essays.

4. Have the students develop a coding system for products. The code might include labels that identify "ideal" packaging, "sometimes good" packaging, "often poor" packaging and other labels. Who will decide what labels go where? What would change the ranking of an item (such as the development of a new recycling technology)?

Section IV

Life Cycle of Product Packaging

Lesson 4.1
Life Line

Objectives:

Students will be able to 1) describe the concept of life cycle of a product; and 2) illustrate the decision points in product life cycles.

Method:

Students will brainstorm and critically consider phases of product cycles in this activity.

Materials:

String; an aluminum can; pieces of aluminum foil; glass container; drink box; plastic container.

Procedure:

1. Talk with the class about the concept of "personal histories." Show examples of how histories are often placed in time lines. Tell the class it is going to help develop "time lines" that are really personal histories of certain products. We do this by considering the life cycle of a product.

2. Where does the product life begin? This is the "virgin material" or raw material that is used to make the product. If the product is aluminum, the beginning is bauxite ore. If glass, sand, silica and lime; if plastic, oil; if a drink box, wood, oil and bauxite. Represent this by stretching the string across the chalkboard or the wall. Put notations for each product at the beginning.

3. Have the class consider every conceivable phase of the material until its "death." Also have the class consider issues such as energy use in the manufacture, transportation and refrigeration of materials. The death or the end of the string could be what? A landfill. Write landfill at the end.

4. Begin with one product. Have the class brainstorm all the different phases. Don't forget recycling, which is an option for all four of the materials. (Pilot programs for many plastics and drink boxes are in operation in the United States! In a matter of time, both will likely be recycled at a much higher rate than they are now.) List all the ideas.

5. Have the class put the different life stages in order on the timeline. There are no really right or wrong life cycles for the products at this stage. The idea is to begin to explore the concepts of extended life and options.

6. Do the same for the other three products. Discuss the final diagram.

Going Further:

1 Have the students find pictures that represent each stage they identified for each product. Do a display of the final pictorial life cycles.

2. Assign individuals or groups specific products. Have them research the life cycle of the product materials. Does what they find support the life cycle the class identified? Have them present their findings to the class.

3. Students can write an autobiography of a product. Starting with birth and going until ultimate disposal, what is the story of the product?

Lesson 4.2
Weight a Minute!

Objectives:

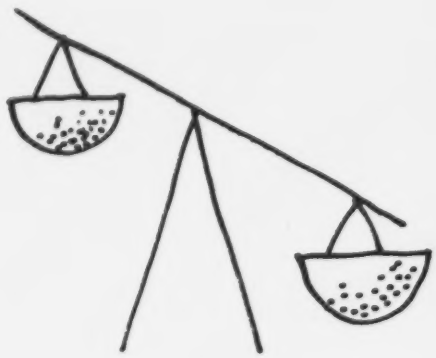
The students will be able to 1) compare items by weight: 2) contrast weight of package by amount of content; 3) chart differences; and 4) (for advanced groups) consider product-to-product ratios.

Method:

Students will conduct measuring/weighing experiments. By recording outcomes and discussion, students will begin to consider product/package decisions.

Materials:

Scales (postage scales and kitchen scales will work); glass, aluminum, plastic and box containers for same amounts of liquid product. Varying sizes of all types is ideal.



Procedure:

1. Tell the students how much material required to make a package is important to the cost of the package. Why? The more of any one material used, the more expensive that package will be. Also, the more material used, the heavier the package, which adds to the shipping cost. As one example, over the last several years, the amount of plastic in pop bottles has been reduced tremendously while keeping the bottle the same size.

2. Show the students the different containers. Have students weigh and record the different weights. You may need to guide younger grades, while older students can record all weights themselves.

3. What ideas do students have from doing this exercise? Does weight of the package make any difference to the manufacturer? To the consumer? To the amount of waste generated?

4. Help the students or have the class develop a chart of the items and the weight of the packages.

5. With more advanced students, have them compute weight-to-product ratios for each container. Chart or graph the results. Which containers have the lowest ratio of weight of container to amount of product? Is this good? Why?

Going Further:

1. Another factor is the strength of the material. The thickness of the product will be related to the necessary strength needed for containing the product appropriately. What materials are light and strong? What materials are strong but thick? Are there ways to combine materials to get benefits of both (such as paperboard and plastic)?

2. Who cares how much a package weighs? Have students weigh "products" such as liquids, paper and pencils. For the same or approximate volume, which product weighs the most? What does this suggest for packaging?

3. Packages serve different functions; different materials serve different functions. Have students develop a list or chart of different materials in packages and the different functions of the material. Then have students begin to identify products that are best packaged in certain materials. What about combinations of materials — what products would they serve best?

Lesson 4.3
One Potato, Two Potato

Objectives:

Students will be able to 1) explain concepts of production and packaging in terms of cost of product (value added); and 2) critically compare different packages and products.

Method:

Survey, discussion, critical analysis will be used to highlight the concepts presented in the activity.

Materials:

Optional: Potato survey form (see Section VI, 6.4).

Procedure:

1. Ask the class why people buy things. Distribute the potato survey or have the students copy the column headings onto a piece of paper. Give them a week to go to the grocery store (if possible, going as a class is ideal) and look for different forms of potato in the grocery store (chips, dried, fresh, frozen, baked, etc.). Record the product, the size (processed weight in ounces), the cost in cents, the price per pound (this may need to be done in class for less advanced students) and a description of the package.

2. When the students have completed the survey, have them discuss the following questions:

   - What effect does processing and packaging have on the product cost?
   - What effect does package size have on price?
   - What effect does package size have on amount of waste?
   - Are any of the packages made from recycled materials?
   - Are any of the products not able to be packaged in recyclable material?

3. Have the class decide if there are wasteful packages in the survey. Why would people buy these packages?

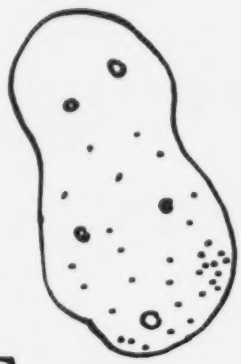
Going Further:

1. Have students in teams choose other fresh produce. Have the teams prepare charts for the produce they select. You may opt to have no teams duplicate their product. Encourage creativity in finding processed uses of the produce (for example, pineapple is often found dried in trail mix; many fruits are dried and in cereals).

2. Have students role play different consumers in different situations. Have one student pro and one student con the packaged material. Encourage other students to support both role players in identifying why or why not produce should be processed and packaged.

3. Students should each select one product. They then write a paragraph describing the benefits of the packaging:

   1. from the point of view of the manufacturer
   2. from the point of view of the retailer/grocer
   3. from the point of view of the consumer



Lesson 4.4
Extending the Cycle

Objectives:

Students will be able to 1) explain how separation of materials is necessary for recycling; and 2) describe the process of hydrapulping for material separation.

Method:

Demonstration and experimentation provide the basis for discussion of concepts on separation of products.

Materials:

Piece of newspaper; portable hand mixer; small bowl; water; drink box; glass.

Procedure:

1. Tell the class that recycling recovers valuable materials but that some products require special efforts to recycle. Hold up the piece of newspaper. Ask the class what would make recycling this paper tricky? The difficulty is that there is ink on the paper. When the paper is hydrapulped (mixed in water) as much ink as possible is removed in "flotation and wash." Bleach is then added to whiten the pulp. This type of difficulty is true for any product that is made of more than one material. Can the class think of any products that are made of more than one material?

2. One product is the drink box that many students use for lunches and snacks. The class can conduct a demonstration that illustrates how hydrapulping is used to separate high-quality paper in drink boxes from plastic and aluminum foil. Fill the small bowl about half full with hot water. Drain the liquid from the drink box into a glass.

3. Have a student tear a 2-inch square from the front panel of the drink box. Place the square into the bowl of water. Have a student place the hand mixer into the bowl and turn the mixer on high speed, keeping the beater on top of the square as much as possible. It will take five to seven minutes for the separation of the materials to begin.

4. Remove the square from the water. The students will be able to see the three different materials: plastic layers on the outside and the inside, paper and aluminum foil on the inside. Complete separation may not take place; however, students will be able to see the four components. Where is the ink? Is the paper white? Is this a benefit? Because of the white quality of the pulp, it is usable for high-quality paper products.

5. What can we do with the paper fiber now that it is separated? What might we be able to do with the plastic and aluminum? In

some parts of the United States, the paper is being used for making paper towels and tissue paper while the aluminum and plastic is being used in plastic lumber!

Going Further:

1. In order to extend the life of mixed products, it is important to be able to separate the materials for recycling. Have the class try to find examples of potentially recyclable items that need to have parts separated to make recycling possible. This might include magazines with staples, mixed plastic containers, toys with plastic and metals, plastics with paper, etc. As a group, have the class consider ways that the materials could be separated.

2. With a blender and water it is easy to demonstrate how paper is recycled. Put torn pieces of newspaper into warm water in the blender. You can add a little starch to strengthen the fiber. Blend on high until the paper is pulp. Pour onto a screen and press the excess water out. Why is the paper the color it is? What would be the value of the paper this way? What would be the value if we separate the ink from the fiber?

3. Some plastic drink containers have metal caps and bands. What would happen to the plastic if the metal were not removed? (Impure, the plastic would be unusable.) Have the class create an invention that will automatically remove the metal band.

4. Water plays an important role in many recycling efforts. Where else do we use water to separate things? (Washing clothes, washing dishes, shampooing hair, etc.)

Section V

The Aseptic Package

Lesson 5.1
The Value of Aseptic

Objectives:

Students will be able to 1) define aseptic; 2) describe in their own terms values of aseptic practices in food preparation; and 3) compare alternatives in aseptic practices.

Method:

Through presentation and discussion, students will be exposed to the concepts of food preservation. Experiments and panel testing are optional activities.

Materials:

A can of vegetables; a drink box; a jar of jelly or jam; a frozen vegetables bag; hot plate; vegetables (cut into small pieces); slotted spoon; digital clock; plates; paper; napkins.

Procedure:

1. Using definitions generated by the class and from the dictionary, create a "group" definition of aseptic packaging. Why is aseptic of value?

2. In 1989, the Institute of Food Technologists named the processing of the package as the most significant food science innovation of the past 50 years. The criteria: ensure healthier eating and reduce food bills. Aseptic processing involves high-temperature/short-time (HTST) treatment in which flowable products are heated quickly to a temperature at which sterilization occurs. The product is then cooled and placed into sterile containers.

3. In the United States, the technology has been used primarily for the production of fruit juices in flexible packages known as "brick-style" containers or drink boxes. Compared with traditional canning techniques, the aseptic process allows a substantial reduction in the time necessary for sterilization, which increases nutrient retention, texture, color and flavor while ensuring safety. In addition, foods prepared and packaged in this way do not require refrigeration. European markets feature milk and other spoilable products in aseptic packages because of this feature.

4. Show the examples of food preservation (can, box, jar, bag). Ask if any of the students in the class has ever helped someone "can" some vegetables. These are all means of preserving food — retaining value of nutrients while making the food accessible to people when the food is not able to be fresh such as out-of-season or from a very distant growing region. Has any student ever helped pre-

pare fresh fruit or vegetables for freezing? How about making jellies or jams? If so, have the students share the process with the class — or arrange for the home economics teacher, the county extension agent, home economics or a home economist from a local business (such as a food preparation firm or a public utility) to come into the class to discuss food preservation. The major issue in these food preparation efforts is safety. It is difficult to get rid of germs in the food preservation process.

5. One of the purposes of a food package is to preserve the flavor of the food. Aseptic packages preserve the flavor of the food due to the reduced time required for high temperature exposure.

Going Further:

1. Bring in samples of different fruits and vegetables. Cut the food into small pieces and allow everyone to taste the foods while you bring water to a boil over a hot plate. Explain that to preserve foods, the food must be cooked to remove bacteria and other potential pathogens. Ask what happens when food is cooked. Put several pieces of one type of vegetable or fruit into the boiling water (carrots and apples work very well). Have one student time the food (in minute intervals), another student write labels for number of minutes, and a third student to remove the food from the water. Allow the food to cook as students answer the question: What happens the longer the food is cooked? Every minute or two, remove another piece of the food. Place the pieces on plates marked with the time labels. Have the students evaluate the texture, the appearance and the quality of the foods. What does this suggest about the ability to shorten the time before the food is sterile enough to preserve?

2. Have the students form teams. Each team will become a "taste test panel." Have each panel create a judging sheet. What is important to each team regarding food. Will they include appearance, texture, taste, color, firmness? How will they rate each item? Have each team find similar food items in cans, boxes, jars and freezer bags. Let each team rate their foods. Share the results.

Lesson 5.2
Less is More

Objectives:

Students will be able to 1) describe the relationship of weight of package to weight of product; 2) compute percentages of package weight to content weight; and 3) compare and contrast different packages.

Method:

Students will experimentally compare the weights of different full and then empty containers and compute the percentages of package weight.

Materials:

Unopened: a drink box; an aluminum can; a gable top carton (milk box); a plastic bottle (soda); a steel can; a glass bottle (soda); a scale (such as postage scales); paper cups.

Procedure:

1. Reintroduce (or discuss) the concept of reduction of waste as the highest priority in waste management.
2. True reduction of packaging waste relates to how much material is required to hold a certain amount of product. Show the unopened containers. Ask the class how as a group they could determine how much container there is for how much product. Probe until a suggestion is made to measure (weigh) the container full, then measure the same container empty.
3. Have a few students develop a chart on which the class will record their findings or use handout sheet in Section 6.5. The chart will need to identify the container, the weight of the full container, the weight of the empty container and the weight of package as a percent of the total contents plus package. Have other students prepare the scales and the products for measurement.
4. Weigh each of the full containers and record the weight. For lunch, or a break, have the students "empty" the containers (a nice bonus for the class!). (Different beverages have differing densities. To be truly scientific, use water!)
5. Have the students weigh the empty containers and record the weight. Divide the weight of each package by its full container weight and multiply by 100. This is the weight of the package as a percent of the total contents plus the package.
6. Discuss the results.

Going Further:

1. Packaging firms want to provide the least weight of package for the most product. Can any of the students think of examples of packaging that tries to use "less"? One example is the plastic beverage container. As the technology improves, the plastic container becomes thinner and thinner. Ten years ago, the plastic 2-litre bottle was much more rigid and heavier than today's 2-litre bottle. Are there other examples? Which materials are difficult to make lighter?

2. Have the students interview friends and family regarding their ideas of "lightweight" packaging. Do they prefer lighter or heavier packages? Do they prefer non-breakable packages? What size containers do they like the best (such as single serve or multiple serve)? Have the class compile a report on their findings.

3. Using the percentages of packages to total contents plus package, have the students decide if their measurements support the following claims:

   - If nine out of 10 single-serve glass bottles were recycled, the one remaining bottle sent to a landfill would create more than twice the waste, by weight, of 10 drink boxes.
   - A typical drink box is 96% beverage and 4% packaging material.

   How could the class decide if these figures are correct:

   - The total packaging weight in pounds it would take to hold 1,000 gallons of beverage are:

Drink boxes (8.45 oz):	524
Gable top cartons (64 oz):	542
Plastic bottles (96 oz):	670
Gable top cartons (8 oz):	1,080
Metal cans (46 oz):	1,306
Glass bottles (64 oz):	3,765

   - Have the students create bar charts that illustrate these numbers.

Lesson 5.3
Energy in All Ways

Objectives:

Students will 1) be able to identify the multiple requirements for energy in product cycles; and 2) compare and question the concepts of energy use and conservation in manufacturing/recycling.

Method:

Discussion and questioning techniques are used to involve the students in critical thinking activities.

Materials:

Chalkboard and chalk; different containers (can, bottle, drink box, plastic container).

Procedure:

1. Discuss energy: what it is, how we use it and why it is considered a resource.

2. Have the class identify all the uses of energy in the manufacture, shipping, handling and use of beverage containers. Is any of the energy "free"? What about "human energy," also known as labor — Is it free? Record the uses of energy on the chalkboard.

3. Show the different containers. Discuss the energy needed to create each container. There is energy required not only for the manufacture of the container, but also for the sterilization of the food product, putting the material into the carton, and closing the container to seal the product. One feature of the drink box is the microthin layer of aluminum between layers of food-grade polyethylene (plastic). The aluminum accounts for about 6 percent of the total weight of the drink box and provides a barrier against air and light. The amount of aluminum in the carton saves more energy than is needed to make it since it allows the beverage to be kept without refrigeration.

4. Once the product is packaged, it must be stored and then taken to a retail outlet. What factors contribute to storage and shipping? (One major factor is weight. Another consideration is space.) How much space is used versus how much space is "wasted"? Ask the students to compare the can, bottle and box. Which of these is the most space efficient? Why?

5. In shipping, the space required becomes very important. It takes one tractor-trailer to haul 1.5 million empty aseptic cartons. It takes more than 14 trucks to haul the same number of empty glass bottles. Because the boxes weigh less and are more compact, shipping is more efficient, which reduces both fuel consumption and exhaust emissions. (Cartons are shipped flat, which saves space.)

6. Another energy use is in recycling. Shipping materials back to a processor requires energy and the same conditions apply. In recycling, energy is required in many ways: crushing glass, metals and paper products to allow for more efficient shipping; separating materials; remanufacturing (such as furnaces for glass and smelting metals; and hydrapulping for the boxes); and for producing a clean product. In the drink boxes, the printing is done only on the top layer of polyethylene, not on paper. This means that there is no need for "deinking" of the high grade paper that makes up 70 percent of the drink box. This high-grade paper, through hydrapulping, is a pure white paper that can be used to make high-

quality paper products — much better paper than is recycled in office paper recovery programs (called high-grade paper recycling). The leftover plastic and aluminum from the hydrapulping can be mixed with other plastics and recycled into products that are made from mixed plastic materials.

Going Further:

1. Have the students create a list of comments, positive and/or negative, regarding the drink box and energy use/conservation. As a class, compose a letter to the Aseptic Packaging Council asking for answers to their questions. The address/phone number is:

   Aseptic Packaging Council
   1000 Potomac Street, N.W.
   Suite 401
   Washington, D.C. 20007
   1-800-277-8088

2. Form the students into "teams." Assign each team the task of creating a package for a different part of a meal (such as vegetables, soup, salad, beverage, dessert, ice, meat or main course). Using the examples of containers, have the students design an "ideal" container for their product. Consider: safety, sanitation, attractiveness, usability, weight, energy, protection, etc. The teams can each present their design concepts in a "design fair." Pictures, models, examples and illustrations could be used.

Objectives:

On the following pages are activities that will help students develop a greater understanding of solid waste and packaging issues, and the impact they have on the environment. Each page can be photocopied and distributed to students.

The handouts are designed to stimulate interest and demonstrate the importance of these facts to our daily lives.

Section VI

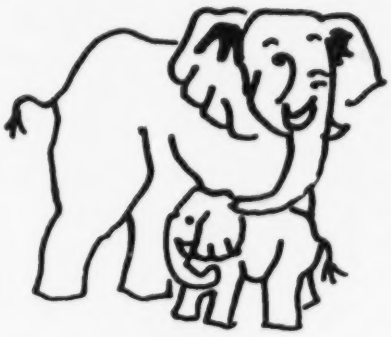
Student Handouts

Create a Fact Sheet

One good way to share information with other people is to use interesting facts and figures. Here are some ways you can create fascinating facts about solid waste that will help you share your knowledge about how much waste we throw away.

Weight Comparisons

- Call a zoo or your local library and find out how much an average full-grown elephant weighs.
- Weigh a pop bottle. How many bottles does it take to equal one pound?
- Multiply the weight of the elephant (pounds) by the number of pop bottles in a pound. This is the number of discarded pop bottles it would take to equal one elephant.
- Find out the number of people in your community and the number of people in your state. Multiply each number by 365.
- Take that number and divide it by the number of pop bottles equal to one elephant. You are ready to make this statement: If every person in _____ threw away one pop bottle per day for one year, the total weight of the pop bottles discarded would be equal to _____ full-grown elephants!



(A) Weight of elephant _____

(B) Weight of pop bottle _____

(C) 1 pound divided by weight of pop bottle _____

(D) Weight of elephant (x) no. of pop bottles/pound _____

(E) Number of people in my community (x) 365 _____

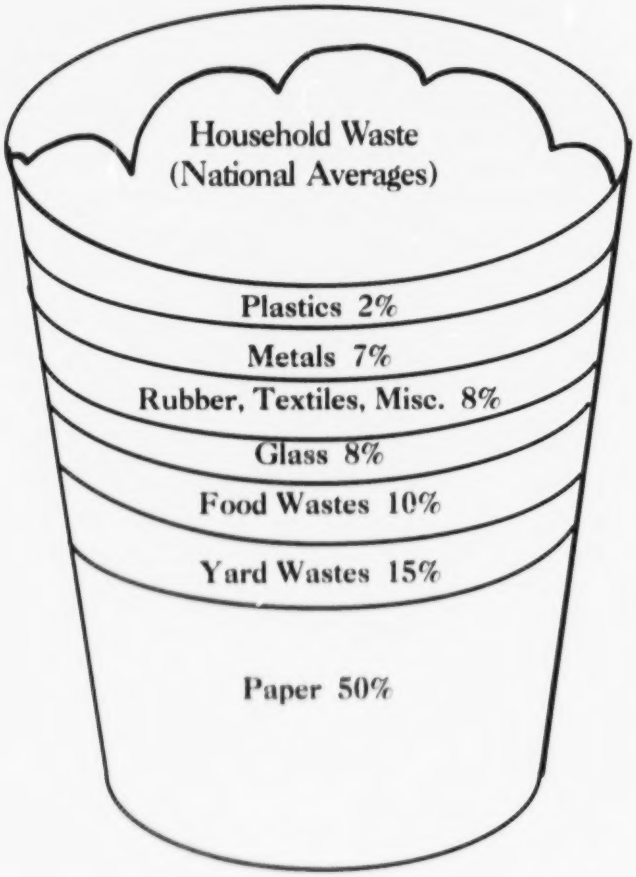
(F) Number of people in my state (x) 365 _____

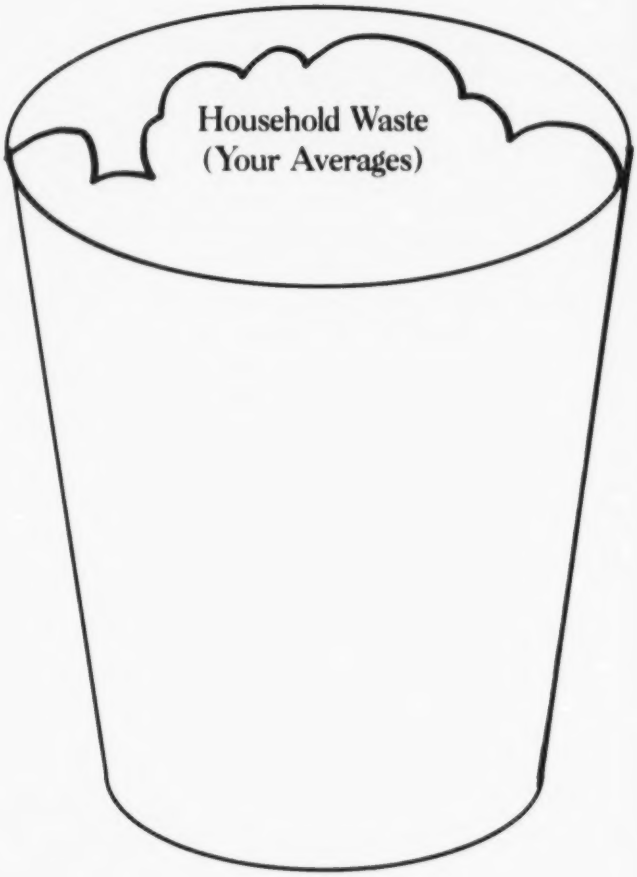
(G) "E" or "F" divided by (D) = _____ full-grown elephants!

You can use the same process for any single item of waste and any comparison you wish to make!

Trashy Comparison

Here's a picture of a trash can with the national "average" of household wastes generated. In the trash can on the right, draw in the percentages of trash in your family's waste.





You, the Wunderkind!

You have just received a multi-million-dollar contract as a designer from an international conglomerate. Wow. As your first assignment, they want you to design a small, convenient trash can that will keep materials apart for separation programs. This way, recyclables will be in separate compartments, compostable items in another and burnable items separate still. They want this to be attractive, convenient to use and versatile. How would you sell this product? Draw your ideas here. Oh, by the way, the CEO has said if you don't succeed ... you're history.

One Potato, Two Potato

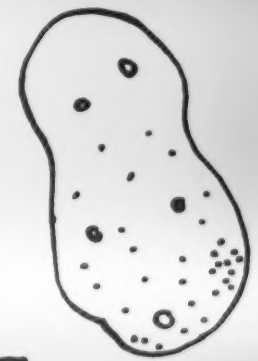
1. Why do people buy things? For one week, go to the grocery store (if possible, going as a class is ideal) and look for different forms of potatoes in the grocery store (chips, dried, fresh, frozen, baked, etc.). Record the product, the size (processed weight in ounces), the cost in cents, the price per pound (this may need to be done in class for less advanced students) and a description of the package.

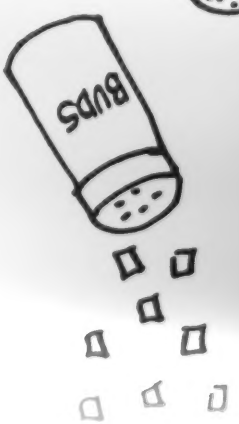
2. When you have completed the survey, discuss the following questions as a group:

   - What effect does processing and packaging have on the product cost?
   - What effect does package size have on price?
   - What effect does package size have on amount of waste?
   - Are any of the packages made from recycled materials?
   - Are any of the products not able to be packaged in recyclable material?

3. Are there wasteful packages in the survey? Why would people buy these packages?

Product	Size (oz)	Price	Package Description	Price (cents)





Weighing the Options

	Type of Container	Weight — full	Weight — empty
	Drink box		
	Aluminum can		
	Gable top carton (milk box)		
	Plastic bottle (soda)		
	Steel can		
	Glass bottle (soda)		

Divide the weight of each package by its full container weight and multiply by 100. This is the weight of the package as a percent of the total contents plus the package. Which type of package has the lowest product/package weight ratio? Which has the highest? Can you suggest alternative packaging options?

Waste Wise
Concepts in Waste Management

A Resource Guide for Teachers
Using Concepts of Critical Thinking
and Decision Making

Aseptic Packaging Council
Washington, D.C.
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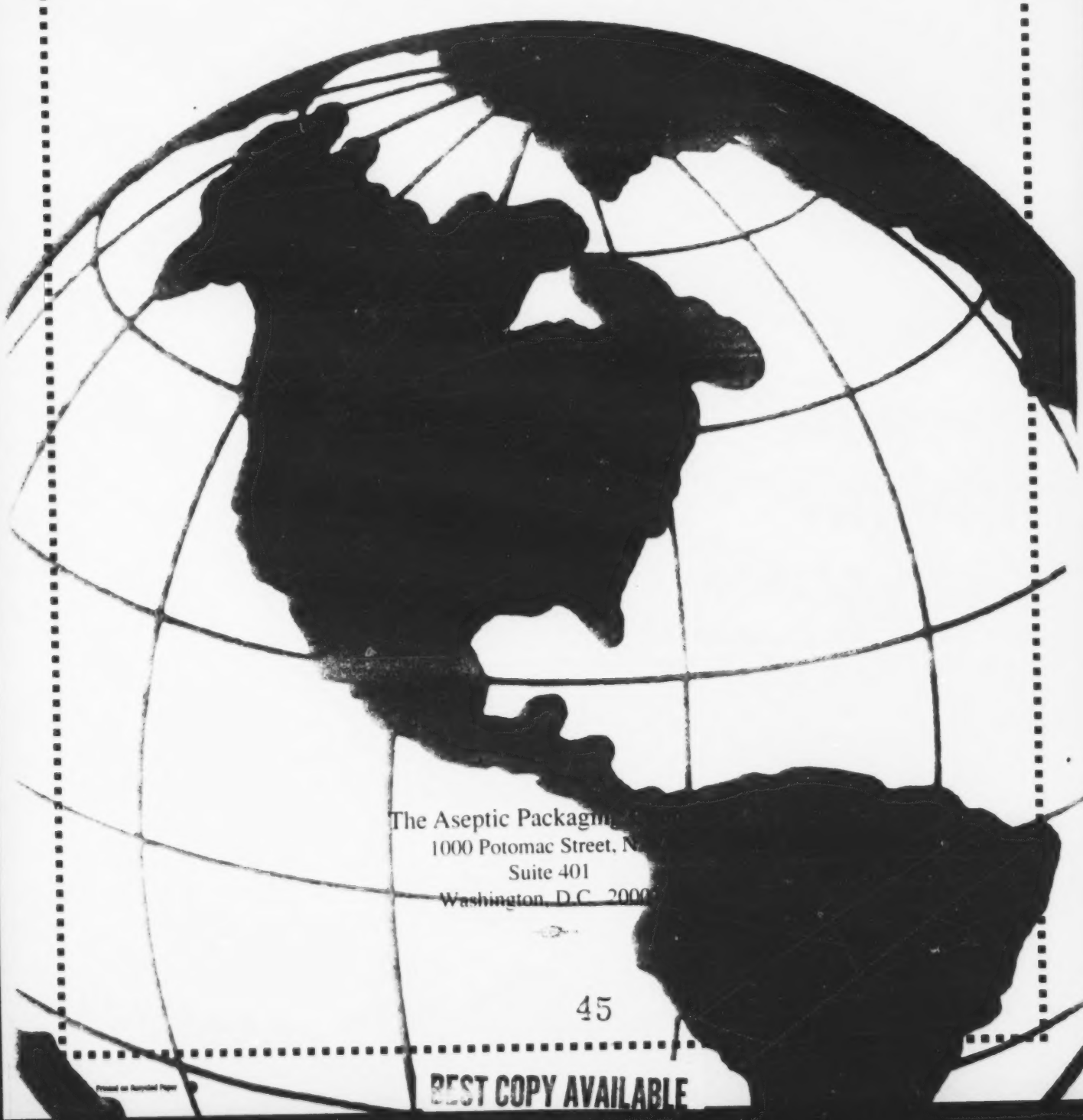
printed on recycled paper



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